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CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

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Front Cover: *Utricularia reticulata* inflorescence, article on page 44. Photo by M. Janarthanam.

Back Cover: *Drosera burmannii* rosettes in western Sydney, article on page 59. Photo by Robert Gibson.

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Letter from the Editor: Facts behind the *Impressum*

Jan Schlauer

Dear fellow carnivorous plant enthusiasts!

Some of you may have noticed a change (in fact a series of changes) in the inside cover of the last issues of Carnivorous Plant Newsletter. These changes were not mere layout face-lifting but in fact they reflect an ongoing restructuring in the organization of the ICPS, *i.e.* in the way Carnivorous Plant Newsletter information is transmitted between its authors, editors, and readers.

Besides these internal factors, an increasing trend towards general standardisation of plant nomenclature in both taxonomy and horticulture has motivated us to increase the responsibilities and the competence of the ICPS and Carnivorous Plant Newsletter. The ICPS has been appointed as the International Registration Authority (IRA) for names of cultivated carnivorous plants (see my notes in CPN 27: 27-28, 128, and Barry's editorial l.c.:99). A newly designed form to facilitate the registration of names of cultivated carnivorous plants is included with this issue. We designed this form to help you register your plants. Completing the form and submitting it for registration to the ICPS will be sufficient for registration. If you prefer to send us the required data without the form, feel free to do so but be sure the required data (description and standard) are all included.

Carnivorous Plant Newsletter is also participating in the test phase for registration of scientific plant names by the IAPT. This does not mean any change for authors who wish to describe new taxa (mostly of wild plants) scientifically in Carnivorous Plant Newsletter. It will, however, guarantee that Carnivorous Plant Newsletter will be able to publish such descriptions in the future if the registration process is adopted by the XVI International Botanical Congress to be held this August in St. Louis, Missouri.

Another development, appearing in this issue for the first time, is the result of several years worth of effort to find "International Correspondents of the ICPS." These correspondents are carnivorous plant specialists whose area of expertise is in some way representative of a wide geographical or taxonomic area. Our correspondents have committed themselves to submit at least one "status report" on carnivorous plants per year. This measure will help to shore up the international status of our society (and of the contents of our journal) that still lists heavily on the US American side (only about 1/3 of our international society is non-USA). Be prepared for more news in due course...

Testing The Appetites of *Ibicella* And *Drosophyllum*

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Keywords: carnivory: *Drosera*, *Drosophyllum lusitanicum*, *Ibicella lutea*.

Received: 30 October 1998

Abstract

A simple method of detecting enzymes was used to test thirteen species. As expected, *Drosera*, *Dionaea*, *Pinguicula*, and *Drosophyllum* were all shown to secrete digestive enzymes. The method was tested on noncarnivorous plants and controls. *Ibicella lutea* and *Proboscidea parviflora* are in the *Martynia* family, and are sometimes suggested to be carnivorous. *Ibicella lutea* and *Proboscidea parviflora* showed no enzymatic activity.

Introduction

In 1997, Siegfried Hartmeyer discovered that *Byblis liniflora* does not produce digestive enzymes (Hartmeyer, 1997), so *B. liniflora* is not strictly a carnivorous plant. Hartmeyer established the hypothesis that it requires the aid of arthropods to benefit from its captured prey (i.e., Hartmeyer, 1998). While his results were fascinating, the experimental method he used, first developed by Heslop-Harrison & Knox (1971), was particularly remarkable because it involved a technique of enzyme testing that is so simple, anyone with a pair of scissors, tape, and inexpensive black and white film could perform it!

In summary, this is Hartmeyer's approach. He stimulated the leaves of carnivorous plants into producing digestive enzymes by smearing them with a yeast solution. Then he placed photographic film (right out of the roll with no processing) in contact with the stimulated leaves. The digestive enzymes from the leaves digested the protein layer of the film, so after twelve hours or so parts of the previously opaque film became transparent. Subsequent photoprocessing was optional.

Procedure

I decided to try the enzymatic test. I bought a roll of Ilford HP5 ASA 400 film (as Hartmeyer recommended) and a packet of baker's yeast. I made a 10% solution of yeast by mixing 7 grams of yeast with 70 ml of distilled water. For each leaf tested, I did the following. 1)I smeared a few drops of yeast solution onto a leaf. Instead of waiting several hours as did Hartmeyer, I immediately proceeded with the next step. 2)I taped one edge of a 2-4 cm length of film to a paper backing. 3)I coded the film with holes from a deftly wielded pin and a hole-puncher. 4)I delicately sandwiched the stimulated leaf between the film and the paper, and taped the other edge of the film to the paper backing. 5)If the film and paper sandwich was too heavy for the plant, I affixed the sandwich to an appropriate support pole. 6)I recorded the details of the trial in my notes, referring to the code I made in step two. 7)I returned the plant to its normal location in the greenhouse for 24 hours before removing the film sandwich.

Some important but mundane matters should be mentioned. First, photographic film consists of an inert plastic layer that functions as a support for the emulsion. When preparing the individual tests, I took care that the dull emulsion

side—and not the shiny plastic side—was pressed against the leaf. Even a hungry carnivorous plant cannot digest plastic! Second, I used acid-free archival cardboard for the backing in each test (specifically, the sturdy paper used in mounting herbarium specimens). Third, when making each film-leaf-paper sandwich, I used the tape to make the sandwich snug enough so it would not slip off the leaf, but not so snug that the leaf was crushed. Finally, as an alternative to yeast, I experimented with using a dilute solution of Bovine Serum Albumin (BSA) to stimulate the plants' leaves. The results in all cases were identical to my yeast trials. (As I dripped BSA onto the glistening leaves I enjoyed thinking how, decades after I killed my first Venus Flytraps by giving them hamburger, I was once again feeding cows to my plants, albeit in the guise of high science!)

The first group of tests included those plants I thought would certainly demonstrate enzyme production. Specifically, I tested *Dionaea muscipula*, *Drosera adelae*, *D. binata* var. *multifida* f. *extrema*, *D.* × *californica*, *D. capensis* (red- and wide-leaved clones), *D. spatulata*, *D. venusta*, and a Mexican *Pinguicula* hybrid of unknown parentage (but obviously closely related to *P.* 'Sethos'). *Dionaea* was tested by feeding the traps small pieces of photographic film which were retrieved from the traps when they reopened a week later. A total of twenty-four yeast and BSA trials unanimously shouted these plants were carnivorous. In Figure 1 I show the results of a test using *Drosera capensis* (a red-leafed clone). The positive enzyme secretions are indicated by the clear spots digested into the normally black opaque emulsion.

Figure 1: Positive enzyme secretions of *Drosera capensis*.

Six control tests were made upon *Abutilon* × *hybridum* 'Sugar Plum' (a non-carnivorous Malvaceous species), and four control tests were made using no plant at all (yeast solution or BSA was applied directly to the film's emulsion). No relevant emulsion damage was observed in these tests. These control tests demonstrated that a lack of enzymatic activity was properly indicated by the method. As a bonus, these control tests illustrated that when kept wet for 24 hours, film emulsion becomes delicate and is easily damaged. Do not mistake such damage for enzyme activity!

The third test group consisted of three species which particularly interested me: *Drosophyllum lusitanicum*, *Ibicella lutea*, and *Proboscidea parviflora*. In each of its five tests, the *Drosophyllum* digested all the emulsion it contacted (Figure 2) and left only the transparent plastic substrate—the evidence of enzymes was clear! Seven trials were made of *Ibicella* and seven of *Proboscidea*, targeting leaves both very young and mature. At the end of twenty-four hours the films showed numerous tiny clear dots or dashes, unlike any seen in the other tests (Figure 3). However,

Figure 2: Positive enzyme secretions of *Drosophyllum*.

these dots were not the result of enzymes. Instead they were caused by the leaf hairs being driven into the emulsion (although I could not tell if the marks were due to the glandular or the longer, eglandular hairs). The stiff hairs had left their imprints in the emulsion! (As noted above, after a day of exposure to water, the emulsion layer becomes mushy and very susceptible to such mechanical damage.) In some cases I used paper clips to hold the film sandwiches onto the leaves, and the clear marks were often clustered around where the paper clips had been, further indicating the marks were a result of mechanical damage and not enzymatic activity. Soaking the leaf with water so the film detached more easily still resulted in some tearing damage.

Ibicella and *Probiscidea* tests in which film was left on the leaves for another twenty-four hours still resulted in no enzymatic damage to the film.

Discussion

My tests have verified the effectiveness of Hartmeyer's method of enzymatic detection, and extended them to show enzymatic activity in a few new genera. A significant oversight in Hartmeyer's work was a lack of appropriate null tests. I have addressed this by showing his method does not falsely detect enzymes when none are present. While he did test *Roridula* as a noncarnivorous species, this plant has a suspicious history in the annals of plant carnivory, and also damaged the emulsion mechanically. More appropriate controls needed to be tested.

Plants in the Martyniaceae, in particular *Ibicella lutea*, did not show any indication of producing digestive enzymes. Is *Ibicella* just another sticky, but non-carnivorous plant? Probably. But it might be carnivorous in one of three ways and still have slipped past my enzyme tests.

First, it is possible *Ibicella* is not carnivorous its entire life and I may have tested it during the wrong time. While both young and old leaves were tested for enzyme activity, might it be that overall plant age is relevant? For example, *Triphyophyllum peltatum* is usually carnivorous only prior to

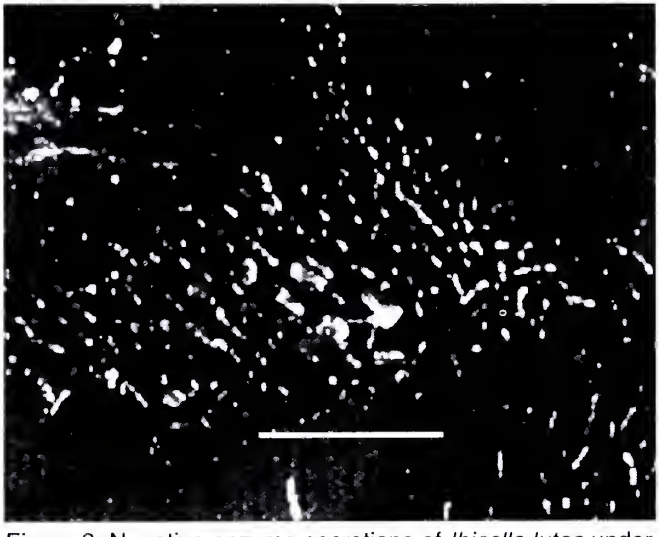

Figure 3: Negative enzyme secretions of *Ibicella lutea* under high power. The horizontal bar indicates 1 mm.

Figure 4: A close-up view of a leave of *Ibicella lutea*, with trapped whitefly and fungus gnats.

changing its growth form into a climbing plant. However, unlike *Triphyophyllum*, *Ibicella* has no habit change so clearly marked. Leaves on branches bearing flowers, fruit, or no reproductive organs were all tested. No enzymatic behavior was detected.

Second, it is possible only specific parts of the plant are carnivorous and were overlooked by my tests. Indeed, small insects are trapped on all parts of the plants except the petals (Figure 4), but only the leaves were tested. Nonetheless, the trapped insects on these untested areas do not appear any more digested than the insects on the leaves. If carnivory were a factor, it would be much more likely to occur over the large overall leaf surface area than the relatively small stem, petiole, or inflorescence surface areas.

Finally, it is possible that *Ibicella* requires an arthropod analogous to those observed on *Roridula* (Hartmeyer, 1998). No arthropod candidates were observed on the plants grown outdoors in Davis, California or Tucson, Arizona. It may be that the appropriate arthropods are only found in the plant's native range in South America, but no such fauna has ever been observed on the related *Proboscidea*, which I have grown for many years well within its native range.

In conclusion, I have found no sturdy evidence that *Ibicella* and *Proboscidea* are carnivorous. Personal communication with Jan Schlauer (1998), revealed he had been unable to detect any enzymatic activity when he applied peptone to the leaves of *Ibicella lutea* and *Proboscidea louisianica*. These are interesting plants, but I have no room for them in my carnivorous garden. The seeds I will send to the ICPS seedbank will be my last.

I would like to thank Tim Metcalf and the staff at the University of California at Davis Botanical Conservatory for the use of their facilities for this experiment. A particular apology is due to any of the staff who brushed against the foul-smelling *Ibicella lutea* plants the long year I grew them at the greenhouses.

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Comments from an ICPS Correspondent: "Nelipu" of van Rheede

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Keywords: observations: India, Nelipu, *Utricularia reticulata*.

In his Species Plantarum, Linnaeus (1753) described seven species of *Utricularia*, but none of them were based on specimens collected from India. However, he quoted "Nelipu," an Indian name, under *Utricularia caerulea*. Later it was proven that the *U. caerulea* described by Linnaeus was a mixture of three different entities. Papers published in the last few decades have discussed nomenclatural problems associated with this name. "Nelipu," probably the first Asian *Utricularia* to be illustrated prior to Linnaeus, did not get a Latin name until Smith named it *U. reticulata* in 1805.

What is Nelipu? The name is Malayalam and refers to how the plant occurred abundantly in paddy fields (Nellu = paddy; Pu = flower). This name, recorded by van Rheede in the seventeenth century, does not seem to be in use any more. In Malayalam-speaking areas (Kerala state) it is known as "Kakapu" (Kaka = crow; pu = flower), probably due to its beak-like spur. In the Konkani-speaking areas (Goa state) it is known as "Kavlya Dole" (Kavlya = crow; dole = eye), although it is not clear how it got this name.

Van Rheede—Heinrich van Rheede tot Draakenstein—was Governor of the Dutch possessions in Malabar (now in Kerala state). He gathered information on the plants of this area and published an illustrated account under the name "Hortus Malabaricus." This twelve volume work is, incidentally, the first work in which the Malayalam script appeared in print, and "Nelipu" appeared in the ninth volume in 1689.

Distribution, Ecology and Morphology

U. reticulata Smith is distributed in India and Sri Lanka (Janarthanam & Henry, 1992; Taylor 1989). In India, it is restricted to the West Coast and lower elevations of the Western Ghats from Saurashtra to Kanniyakumari, spanning a north-south range more than 1600 km long. Taylor (l.c.) also cited Madhya Pradesh, Bihar and Orissa, but I have not seen any specimens from these states in any of the Indian herbaria. Although it is abundantly present in paddy fields, it is also recorded from fallow fields, harvested paddy fields, puddles on rocky plateaus, etc. This plant comes up during July and is seen in peak flowering during September-November. Stray collections have also been made from wet areas in other seasons. In paddy fields it reaches almost 75 cm high, twining among paddy culms (see Front Cover). Violet flowers scattered amidst the emerald green of young paddy plants and the golden yellow of mature paddy plants are worth a sight (Figure 1). In open areas, its scapes twine around grasses, sedges, *Xyris* or *Eriocaulon* species. In the absence of any support they twine around each other to form a rope and support themselves (Figure 3). They are stunted and erect if they happen to grow in wind-prone areas such as the clear slopes of hillocks. In puddles, *Eriocaulon* species and *U. reticulata* form beautiful contrasting rings of violet and white. *U. reticulata* has a distribution sympatric with *U. cecilii*, *U. lazulina*, *U. malabarica*, *U. praeterita*, and others.

Immediately after germination the species forms a mat of linear leaves with abundant traps on the surface of the mud. After two to three weeks the racemes appear with several flowers. The flowers last for several days, and sometimes weeks. These flowers, which are the largest in the genus in India, may measure up to 25 mm long. They are

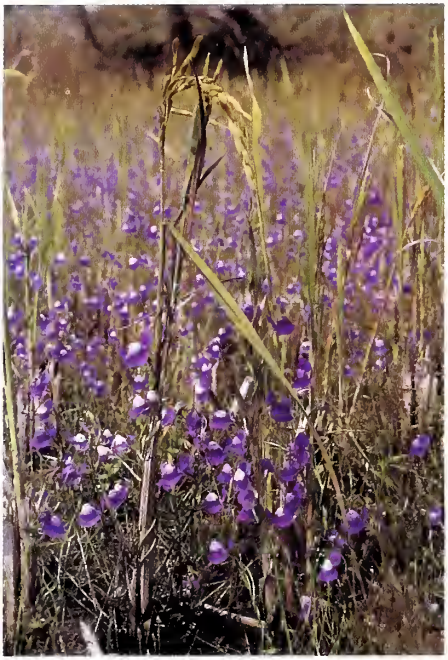

Figure 1: *U. reticulata* in a paddy.

Figure 2: Flowers with a big visitor!

Figure 3: *U. reticulata* flowers with twined peduncle.

usually violet but vary from blue to pink, with intermediate hues. The white, blue or pink patch with colour striations at the centre of the lower lip of the corolla gives a relief to the otherwise monotonous colour. Very rarely white flowers are also seen (Figure 4). *U. reticulata* is an annual, dying off after seed-set.

Related species

Among the Indian bladderworts, *U. polygaloides* is the most closely related, and it is also distributed in India and Sri Lanka. But in India it is distributed along the East Coast from West Bengal to Tamilnadu and the Central parts of India. *U. polygaloides* is an erect species with smaller flowers.

Pollinators

The pollination of this species is not understood well, but they are often visited by bees, including the larger bumble bees.

Cultivation

Interestingly, there are no known cases of cultivation of this beautiful *Utricularia* species in India. If at all a single species from India should be grown, the most suitable one would be *U. reticulata* for its large, beautiful and long-lasting flowers, its twining habit, and the relative ease with which it can be grown. In natural conditions it receives abundant rainfall (often reaching 3000 mm within four months—from June to October). The rainfall is at its peak during the vegetative growth of *U. reticulata*. They grow in open areas or in paddy fields where there is no dearth of bright tropical sunlight. The maximum temperature varies from 25°C to 33°C and the minimum from 23°C to 27°C with relative humidity varying from 70 to 98% depending on the local conditions but usually exceeding 80%. Although the author has not tried growing *U. reticulata* from seeds, it is found that the vegetative mat transplanted from natural conditions fares well under cultivation.

Figure 4: A rare white-coloured flower.

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On Cultivating *Ibicella lutea* (Martyniaceae)

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Keywords: cultivation: *Ibicella lutea, Proboscidea.*

Ibicella lutea and *Proboscidea* species are easy to grow, provided you do two things; first you must convince the seeds to germinate, and second you cannot treat them like carnivorous plants!

Let us discuss seeds. Some strains of *Ibicella* are adapted to cultivation, while other types confound even the most driven and experimental horticulturists. *Ibicella* seeds collected from plants colonizing a weedy lot will probably be difficult to germinate. Obtain your seed from a nursery catalogue, seed bank, or another gardener and they should germinate easily, even if they are several years old.

Seed should be sown 1 cm deep in a rich, sandy soil. High soil temperatures trigger germination, so keep your pots in a sunny spot. Immediately upon germination transplant the seedlings into the pots that will house the plants through maturity. The larger the pot, the larger your plant will be. I use pails at least 40 cm (15 inches) tall (Figure 1). Give the plants full sun and water daily but do not keep the soil sopping wet! Fertilizers are not required, but probably would encourage vigorous growth. I grow this plant outdoors and it is usually beset by white flies and caterpillars. The white flies do not cause too much damage and the caterpillars can be removed manually.

I have noticed *Ibicella* has two flowering phases during its long growing season. The first phase occurs when the plants are just a few months old. The fruit from this first phase of flowering mature in only a month or so. After these first few flowers, the plant stops flowering and concentrates upon growing larger. The second phase of flowering starts when the first crop of seeds are nearly mature. In my cultivation this phase continues until the plants are killed by frost. Fruit take up to three months to mature and grow to 16 cm or longer. Pollinate flowers from the first phase because you may not have the long growing season required to get seed from later flowers. Incidentally, *Ibicella* has sensitive stigmatic lobes that when touched, quickly flex out of the way and enclose the applied pollen. This is obviously an adaptation to avoid self-pollination by pollen-coated insects backing out of the flower. (It appears that moving stigma lobes only occur in the order Scrophulariales, which includes *Ibicella* and the carnivorous genera *Pinguicula*, *Genlisea*, and *Utricularia*.

Figure 1: *Ibicella lutea.*

Figure 2: *Ibicella lutea* claws and seed.

Several species of *Utricularia* have moving stigma lobes.)

After pollination the ovary elongates rapidly. At maturity the green skin of the fruit peels away to reveal the woody interior, which then splits along part of its length and curls into the characteristic "devil's claws" (Figure 2). The seed have an interesting dispersal mechanism. Two rows of seed in the devil's claw can fall out easily; the other two rows of seed may escape only after the woody claws rot away. Since the claws are adapted to hook onto animals, these modifications ensure that some seed fall near the parent plant while other seed may be transported great distances. Clever.

Some people confuse *Ibicella* with plants in the genus *Proboscidea*, but it is easy to tell the genera apart. Both genera have a few narrow bracts at the base of the flowers and petals fused into a tube at the base, but while the five sepals (the calyx) are separate in *Ibicella*, they are fused (connate) in *Proboscidea* (Figure 3). Mature woody *Ibicella* claws are also unique—they are covered with spines. There are yet other genera in the Martynia family, but it is unlikely you would confuse *Ibicella* with them.

If you decide to grow this plant, be aware it is illegal to grow in some areas because the claws of the fruit may annoy livestock. For example, it is declared a noxious (prohibited) weed in Western Australia. It may be illegal elsewhere, too.

I have stopped growing this plant because I do not think it is carnivorous! Furthermore, the foliage smells terrible and I am weary of washing that horrible fungal odor off my hands. (Conversations with Jan Schlauer and Peter D'Amato reveal that not all *Ibicella* plants smell as dreadful as mine do. I am lucky.)

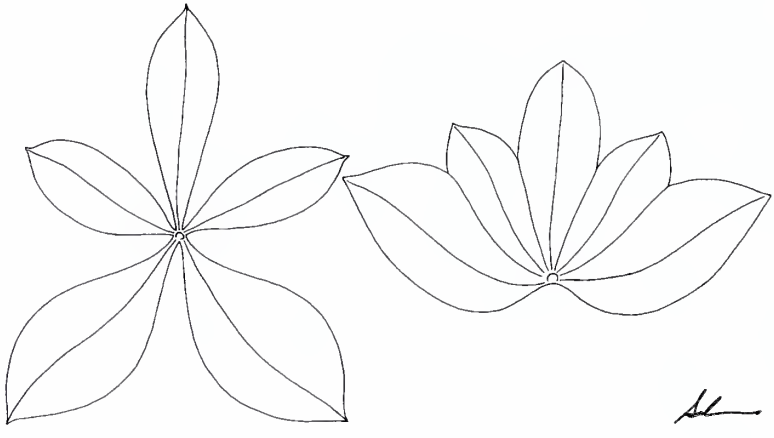

Figure 3: Calyx lobes, *Ibicella* (left), *Proboscidea* (right). By E.M. Salvia.

TESTING FOR CARNIVORY IN *IBICELLA LUTEA*

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Keywords: carnivory: *Ibicella lutea*.
Received: 2 December 1998

Introduction

After reading the article in Carnivorous Plant Newsletter by Siegfried Hartmeyer (1997) and reading Heslop-Harrison & Knox (1971), I decided to try to determine if *Ibicella lutea* could be insectivorous.

The ability of digestive enzymes to dissolve the thin gelatin layer on film was discussed in both articles as a means of determining carnivory safely and quickly. The film is first exposed and then developed but not fixed. The film used in the original paper was Kodalith ortho (ASA 12) and since I had some of this from a previous project, this is what we used as well. I teach in a program for "at risk" high school students and thought they might learn a lot from actually doing a real science project. Students were assigned various known plants (both insectivorous and non-insectivorous) as controls to compare to our test of *Ibicella*. Film pieces were attached to plant leaves and left for 24 hours. They were then looked at under a stereo-microscope to see if the film was dissolved or simply ripped off the plastic backing.

Testing

Three separate tests were conducted with insectivorous and non-insectivorous plants. All plants were grown at my home and not under any special conditions. The plants used in all tests were exposed to food-insects such as fruit flies, and were grown either outdoors or in open terraria.

For the first test at school, I tried to keep things simple. I noted that small insects were present on some of the leaves so I did not try to trigger the digestive response with yeast solutions as used in the literature. Students were told to avoid insects for fear that their digestive enzymes would contaminate the tests. I assumed the digestive response was already activated and/or the plant would test negatively and we would have to try again. The film was cut into pieces and those pieces were attached, gelatin side toward the plant, to selected leaves or plants. Tape was used to keep the film in place and ensure close contact between the film and plant. The film was left untouched for 24 hours until the following class period. The films were then examined under the microscope to see if the holes in the gelatin were due to dissolving by enzymes or had just been ripped off by the fluid on the leaves. Photographs of representative films were taken to show our results. I also took some film home and attached it to other plants, including unidentified hirsute yard weeds, to provide a larger sample group with which to compare.

There seemed to be a positive result for *Ibicella*. When the positive results were reported to the ICPS internet listserve, we found that others had gotten negative results in testing *Ibicella* (Meyers-Rice, 1998; Schlauer, 1998). A second set of tests was conducted in a very careful manner using the yeast solution as described in Hartmeyer (1997). The solution was left on the leaves for 12 hours and then the film pieces were attached as before. They were again left for 24 hours. This time we got negative results for *Ibicella* but noticed that there were interesting staining features for *Ibicella*, a poor enzyme test for *Byblis gigantea* and a fading of the film when tomato plants were tested. We wanted to see if we could clarify these test

results so that they would become clearly positive or negative. Tests were run for a third time, and the films were left for 48 hours. The results were clearer and *Byblis gigantea* was clearly insectivorous, tomatoes were clearly negative and *Ibicella* tested negative again (although the staining was still very clearly visible).

Our preliminary results for *Ibicella* must have been contaminated. Either insect digestive enzymes were on the leaf on the tested sections or the student accidentally got enzymes from an insectivorous plant on *Ibicella* when taking it out of the box the plants were transported in. After previewing this paper, Barry Meyers-Rice pointed out that the apparent enzymatic activity I observed in *Byblis filifolia* is very interesting since its close relative *B. liniflora* does not produce digestive enzymes. Since *B. liniflora* and *B. filifolia* are such close relatives, this matter deserves more study.

Plant	Comments on enzyme test
Test 1	
Byblis filifolia	Positive
Drosera adelae	Positive
Drosera burkeana	Positive
Drosophyllum lusitanicum	Positive
Ibicella lutea	Positive
Tomato	Negative
Unidentified yard weeds	Negative
Test 2	
Byblis filifolia	Positive
Drosera adelae	Positive
Drosera binata	Positive
Drosera burkeana	Positive
Drosera capensis—White Flower	Positive
Drosera collinsae	Positive
Drosera graminifolia	Positive
Drosophyllum lusitanicum	Positive
Tomato	Inconclusive or negative
Byblis gigantea	Inconclusive
Ibicella lutea	Inconclusive
Test 3	
Byblis gigantea	Positive
Tomato	Negative
Ibicella lutea	Negative, but with dark staining

References

Hartmeyer, S. 1997, Carnivory of *Byblis* Revisited—A Simple Method For Enzyme Testing On Carnivorous Plants, Carniv. Pl. Newslett., 26: 39-45.

Heslop-Harrison, Y., and Knox, R.B. 1971, A Cytochemical Study of the Leaf-Gland Enzymes of Insectivorous Plants of the Genus *Pinguicula*, Planta, 96: 183-211.

Meyers-Rice, B.A. 1998, personal communication.

Schlauer, J. 1998, personal communication.

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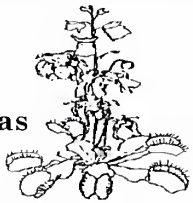

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Special Announcement
ICPS World Conference 2000

David O. Gray • 584 Castro St. #687 • San Francisco, CA 94114 • Davidogray@aol.com

The date and location for the next ICPS conference have been set! The Bay Area Carnivorous Plant Society (BACPS) is proud to host the conference, at the Fort Mason Center in San Francisco, Friday June, 16th—Sunday, June 18th, 2000. The three day event will be filled with talks, workshops, and fun. Following the conference will be a Do-It-Yourself Field Trip to see *Darlingtonia californica*, *Pinguicula macroceras,* and *Drosera rotundifolia* in the dramatic environs of northern California. BACPS will provide information and maps and is planning an informal picnic for Tuesday the 20th in the Redwoods. You can find out more about the conference and up to date information at the ICPS web site at http://www.carnivorousplants.org/2000.html

Overlooking San Francisco Bay with sweeping views of Alcatraz Island and the Golden Gate Bridge, the Fort Mason Center is near reasonably priced lodging, and a hostel is on the grounds of the Fort. The famous Fisherman's Wharf is a short walk and, in a city noted for its restaurants, there are wonderful dining options in every direction. In the city's Golden Gate Park are Strybing Arboretum with its many diverse plantings from around the world (free and open every day) and by 2000, the elegant Conservatory of Flowers will be restored and open to display its collection of tropicals including *Nepenthes*. Across the Bay is the University of California Botanical Gardens in Berkeley with its extensive collection of carnivores.

A registration form is included in this issue, and can also be downloaded from the ICPS website. There is a substantial discount for registering early, so do not wait. For those members registering from outside the United States, contact your local society and see if you can arrange group discounts or other money-saving options. There are about 200 seats for the conference but please do act quickly; your early registration will help make this conference a success. Looking forward to seeing you in San Francisco, "Everybody's Favorite Town!"

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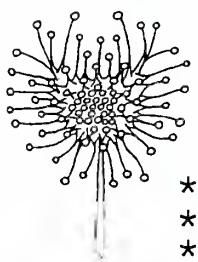

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Literature Reviews

Adam, J.H. & Wilcock, C.C. "1995" (probably not published effectively before 1997), Sarawak Museum Journal, 50, 145-171.

This is an interesting paper for several reasons. The most intriguing facet of the present work is the resurrection of the dubious name *N. curtisii*. In the way *N. curtisii* was first described, it was a straightforward synonym of *N. maxima*, except for the fact that *N. maxima* is not known from Borneo. The original material of *N. curtisii* (most probably collected in Celebes but labeled as from Borneo) has rather certainly suffered from label confusion. (The description and the illustration published by Masters leave remarkably little room for speculation.) Anyway, the present authors interpret *N. curtisii* in such a wide sense that *N. fusca s. lat.* (specimens from northern Borneo, *N. stenophylla* Mast. *s. str.*?) is entirely absorbed into the taxon thus delimited. The rather grave and numerous nomenclatural consequences of this decision (should it be taken seriously) are not even briefly mentioned in the present paper, and no synonyms are given.

Quite correctly, the authors have recognized that the species Danser confused with *N. stenophylla* (*N. stenophylla auct. non* Mast.: Danser) cannot be included in the original concept of *N. stenophylla* Mast. (as defined by Masters' original description, an illustration of the type specimen published by Masters, and a fragment of doubtlessly pertinent material conserved at Kew). Unfortunately, they overlooked or ignored that *N. fallax* is the valid and unambiguous name applicable to *N. stenophylla auct. non* Mast.: Danser. They have instead coined the new (taxonomically synonymous) name *N. sandakanensis* for it.

Thus, we know for sure now (or we are reminded once again) that there will never be stability in *Nepenthes* nomenclature if the cases of *N. stenophylla*, *N. fusca*, *N. fallax*, and *N. pilosa* are not revised with appropriate thoroughness and care. If this is not done, it can be predicted with great confidence that further nomenclatural shindogus will be born in profusion. (JS)

Brewer, S. 1998, Effects of Competition and Litter on a Carnivorous Plant, *Drosera capillaris* (Droseraceae), Am. J. Bot. 85, 1592-1596.

Studies of seedling densities and survival rates in response to various conditions of soil treatment (removal of leaf litter, herbicide application, removal of woody plants) showed that the establishment of *D. capillaris* is limited in part by the effects of litter on seedling density in both open areas and shrub thickets. It is surprising to find such unsurprising data published in a full paper. (JS)

Cheek, M. & Jebb, M. 1998, Two New Philippine *Nepenthes*, Kew Bull. 53, 966.

Obviously in great hurry, the items mentioned in the title are featured to meet the formal requirements of effective publication. While location details are withheld in order to impede the craft of illegal plant collectors, researchers who are not fortunate enough to know where the specimens originate also suffer because of this omitted information. Fortunately, however, both species have actually been discovered previous to the 1998 expedition that yielded the specimens described in this paper, and pictures of them (not mentioned in the present paper) have been posted for several months on the internet. The diagnoses (no descriptions are given but they are promised to appear "shortly" together with illustrations) are so brief that it can only be gathered from them that the new species differ from their supposed

close relatives by lacking their distinctive features (*e.g.* the separated peristome teeth of *N. villosa* are missing in *N. mira*, and the large glands along the median line of the lid of *N. macrovulgaris* cannot be found in *N. wilkiei*). This would in the worst case leave room for the speculation that they are not even related to the species they are compared with. For more information consult:
http://www.altu.net.au/~philmann/page10.html
The picture labeled "*N. alata* Palawan Island, Philippines" is of *N. wilkiei*, cf. CPN 27: 7, Figure 5, 1998, and
http://www.borneoexotics.com/phil_photos.htm
The picture labeled "*N. sp.* #5" is of *N. mira*. These photographs may also be viewed at the ICPS web site. (JS)

Midgley, J.J. and Stock, W.D. 1998, Natural Abundance of $\delta\ ^{15}N$ Confirms Insectivorous Habit of *Roridula gorgonias*, Despite it Having No Proteolytic Enzymes, Annals of Botany 82, 387-388.

In this research article additional proof is presented for the theory that *R. gorgonias* has carnivorous properties although it lacks digestive enzymes. The ratio of the nitrogen isotope ^{15}N compared to the more abundant isotope N differs consistently between insects, atmospheric nitrogen, nitrogen containing salts in the soil and plant tissues. In previous studies it has been shown that insects have a higher $\delta\ ^{15}N$ ratio than plants, and carnivorous plants have been demonstrated to display higher $\delta\ ^{15}N$ values than non-carnivorous plants. In the present study, adult plants of *R. gorgonias* are stated to have a $\delta\ ^{15}N$ value far higher than juvenile plants of the same species, non-carnivorous reference plants, or even two *Drosera* species. This is taken as indirect evidence for carnivory in *Roridula gorgonias*. The leaves are furthermore demonstrated to exhibit a strong reflexion of UV light, which is thought to be particularly attractive for insects, another feature common in carnivorous plants. (JS)

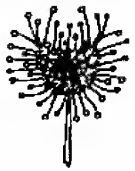
Romero, G.A. *et al.* 1998, Aracamunia, Orchids, 67: 1155-1157.

Why are we writing a literature review of an article about an orchid? It may (emphasize on *may*) be the first-described carnivorous orchid! The authors came across this new, so far monotypic genus while exploring the tepui Cerro Aracamuni in the Venezuelan Guayana. The plant was thus named *Aracamunia liesneri* Carnevali and Ramirez in honor of its location.

The little plant only stands 5-6 cm (2-2.5 inches) tall and grows in a habitat similar to those of carnivorous plants on the tepui. It is placed in the subtribe Spiranthinae which contains, among other genera, the familiar Ladies' Tresses (*Spiranthes* spp.). The structures that make it suspiciously carnivorous-looking are small, ligulate (tongue-like) structures at the bases of the leaves. These structures have distinctive glandular heads. Unfortunately only a few plants fixed in alcohol have been collected but these will be subjected to microscopic tissue studies to gather further information on the nature of the glands. Of course, if possible, further study on living material would be required to evaluate the possibility of digestion and absorption of prey products, and to attempt to grow the plant *ex situ*. There is some urgency for further study of living material—the species is known only from one tepui and it is subject to illegal mining activities, with habitat damage furthered by trampling by government officials and military attempting to stop the mining! (DES)

The Savage Garden

Peter D'Amato • California Carnivores • 7020 Trenton-Healdsburg Road • Forestville, CA 95436 • USA



Keywords: cultivation: *Drosera madagascariensis*, planting media, *Utricularia*.

Coco Chips!

Roger Hoelter of Santa Barbara visited me this past weekend, and with him came two large sacks of another coconut horticulture product. The label on the sacks simple said, "Coconut husk chips: a product of Sri Lanka." Airy and lightweight, these chips are about 0.6 cm (1/4 inch) on a side. It may be good for *Nepenthes* soil media, and looks more promising than "Coco peat" was. I have mentioned in a past column (CPN 27:4, p100) my disappointment with the Coco peat product, which in my experiments quickly broke down into a mushy, slimy mess. These new chips look much more durable and long-lasting. Roger said orchid growers in Santa Barbara were disappointed in this new product because it held water too well (most orchids appreciate drying out somewhat between watering). Sounds perfect for *Nepenthes* and perhaps *Heliamphora*, so I will experiment with it as an ingredient in soil recipes and report later on the results.

An interesting (and hopefully the last) afterword to the Coco peat disappointment occurred at this year's Nor Cal Show, where wholesale vendors catering to the garden industry in northern California display their wares. You may recall that it was at last year's show that I was first seduced into trying Coco peat, as every vendor of soil products was pushing it as the most wonderful ingredient to hit the market since perlite. This year, however, Coco peat was scarcely seen. When Marilee questioned one vendor about this absence, she was told most growers had disappointing results using Coco peat because of a high salt content of the coconut fiber! Coconut palms grow best along the salty beaches of the tropics, tolerant of salt water and salt spray, and thus it remains in the coconut husk and its pulverized peat product that first seemed so promising. Coco products from Sri Lanka, which are grown inland, are allegedly low in salts—much to my relief as I had just used the Sri Lanka chips in my *Nepenthes* mix.

Drosera madagascariensis

Some folks on the carnivorous plant listserver chat line inquired about a plant I have circulated as *Drosera* "Botswana." Although I am not a taxonomist, it appears this plant is *Drosera madagascariensis*, native to Madagascar and Africa.

This plant was originally given to me by an actor who, at the time, did stunt work and played roles on the popular and controversial television show called "Power Rangers." I have not seen him in a few years, but if my memory serves me correctly, he said he found the plant growing in a water ditch close to the Botswana airport.

I have become very fond of this plant, and many of my visitors have been pleased with it as well. This strain of *Drosera madagascariensis* forms a cluster of circular leaf blades with narrow petioles about one or two inches long, reminiscent of *D. intermedia*. Like that species, it forms long trailing stems, but up to 30 cm (12 inches) long. It makes new shoots from the base of the stem, so in time the plant produces a clump of stems of varying lengths, each cloaked with dead leaves and topped with an attractive rosette of new lamina. The leaves are pale in subdued light, but in strong light they become a lovely crimson.

I grow this plant in my warmhouse. In winter the growing points die back and the plants go through a dormancy for a few months. I never let the soil dry out. In spring, new plants appear from the lower stems and roots. Customers report that in terrariums under grow lights and a longer photoperiod, the plant continues to grow sending up new stems as older ones die away.

One of my specimens sent a flower stalk of about 15 cm from a lengthy stem. I missed the blooms and do not know their color, but I assume they are white or pink. They self-pollinated and produced abundant seed. I have propagated the plant easily from leaf cuttings. I have yet to find out if the plant is tolerant of light frost when dormant, but my guess is that it is. I have not yet experimented with this wonderful species as a windowsill plant, but for greenhouses and terraria it is ideal!

A Bowl of Bladderworts

This is not some side-dish served up for dinner by the Munsters or the Addams Family, but is an interesting way to make a carnivorous plant color bowl using similar species of one genus. The end results can be a beautiful display of miniature, orchid-like flowers that will provide waves of delicate color explosions that even your grandmother will love.

The idea is simple and obvious: grow several species of terrestrial or semi-aquatic bladderworts together in one container. I like to use decorative, glazed ceramic bowls without drainage holes, and of a neutral color. Small bowls less than 20 cm (8 inches) are suitable, but large ones 25-35 cm (10-14 inches) are even better, as they will ultimately accommodate more plants. Their depth should be at least 5 cm (2 inches).

Use a pre-wetted planting mix of one part sphagnum peat to one part sand. You could use long-fiber sphagnum, but pack it tightly into the bowl. The planting medium should fill the bowl to 1 or 2 cm (0.5-1 inch) below the bowl's brim to allow for occasional flooding.

I like to use terrestrial species from temperate, warm-temperate, and subtropical climates that flower fairly regularly or profusely during much of the year. I insert small divisions of established plants, about 2.5 cm (1 inch) square, into the surface of the soil. For a 30 cm bowl, about two or three divisions of each species, planted randomly, works well. In a few months these plants will fill the soil with intertwined stolons and bladders, while the surface becomes covered with a thick mat of tiny stolons. Several species must be used to produce the best effect.

Two species that flower the most and can be in bloom for months at a time are *Utricularia sandersonii* and *U. livida*. The "blue form" of the former plant flowers less prolifically than the common variety, but it spreads by rapidly growing stolons above the soil surface that may even spread to adjacent pots. Another good species is the famous weed, *U. subulata*, with its delicate sprays of sulfur-yellow flowers. When the frequently produced cleistogamous (non-yellow) seed capsules are produced, I quickly trim them off as I find them messy and unsightly. *Utricularia cornuta* is similar in shape and color but comparatively huge and longer lasting.

Utricularia dichotoma will provide on-again, off-again tall spikes of deep purple/blue, fan shaped blooms that will tower to 30 cm (12 inches) tall. *Utricularia bisquamata*'s flowers are tiny, multicolored gems, but are larger and more brilliant in full sun. Reaching their peak in late summer and autumn, *U. graminifolia* provides lower-growing, pink and puffy blooms with a blue tinge for several weeks. *Utricularia arenaria* has small, deeply purple flowers with a touch of yellow.

Other species may work well, but the above plants are the most commonly available and flower for long periods. A bowl of bladderworts requires partly to full sun conditions for the most profuse color shows. Many terrestrial bladderworts flower *en masse* after periodic floodings in the wild, so every month or two during the growing season I raise the water level to a shallow half inch or so above the soil surface and keep it flooded for a week or two. The rest of the time the soil should be damp to wet. Do not fret about feeding them daphnia or other tiny critters. Instead, about once a month during the warmer seasons, lightly mist the surface stolons with an epiphytic, acid, or orchid fertilizer diluted to about 1/4 the recommended strength. Always water with pure water. All above species do nicely on sunny windowsills, under growlights, in cool and warm greenhouses, and can tolerate light frosts or occasional freezes of brief duration, so they make handsome patio or deck displays in suitable climates. In the summer, when several if not all the species flower at the same time, the results can be most impressive, and may win you a ribbon at the county fair!

Special Review: Heavy Duty Large Growing Trays

During a recent trip to the lands of my birth I visited a large orchid farm. I discovered this nursery sells plastic growing trays that would be marvelous for the home or greenhouse carnivorous plant grower. These large rectangular trays measure 121 × 56 cm (47.5 × 22 inches) on the outside, and provide a growing area of 116 × 51 cm (45.5 × 20 inches). Notice this length is a good match for 48 inch fluorescent fixtures so commonly used in the US. The walls are fully 7 cm (2.8 inches) tall, making the trays deep enough for most growing arrangements. For added strength the bottoms of the trays have ridges 1.3 cm high (0.5 inches). This feature, combined with the overall thick plastic construction (3mm, or 1/8 inch thick throughout), results in a very sturdy tray that will not wobble or break, even if loaded with pots! The ridges on the tray bottoms decrease the usable depth a small amount, but not too badly. The trays are undrained, but if you wanted to change that you could using regular hand tools. My only criticism of these trays is that they are only available in black—black trays absorb more sunlight than white trays and tend to heat the tray water. If you have temperature problems in your growing situation, this may be a consideration.

The trays are not cheap! They cost $39.95 + tax at the store (the nursery will ship anywhere in the US, bringing the price to $47.50). To order the trays, contact Orchids by Hausermann at 2N 134 Addison Road, Villa Park, IL 60181-1191, email hausermann@compuserve.com, or phone 630-543-6855. Ask for their "Large Growing Trays." You may want to ask for their catalogue—they sell other interesting items such as New Zealand *Sphagnum* for $32.99/kg, or $5.95 for 1/4 cubic foot (shipping is extra). (BAMR)

The ICPS Logo Winners

Barry Meyers-Rice

At last, the results of the ICPS logo contest can be announced. We had a good contest turnout with eight artists submitting sixteen entries. The ICPS judges were Rick Walker, Jay Lechtman, Jan Schlauer, Leo Song, Joe Mazrimas, Steve Baker, Tom Johnson, Madeleine Groves, Carl Mazur, and myself.

Casting their votes was unexpectedly difficult for the judges. I think this is because the ICPS is an organization with many different faces: horticulturists, scientists, conservationists, and lovers of the weird; beyond even that, many ICPS members favor some carnivorous plants over others. How could a single logo encapsulate all this diversity? Ultimately, the obvious image of a Venus Flytrap won the day. Venus Flytraps are uniquely famous, and are instantly recognizable even to those who do not know the difference between a sundew and a radish.

The bold and talented artists were, in alphabetical order, Richard Ellis, Rick Meyer, Paul Milauskas, Matthew Sheehan, Jr., Vincent V. UyBarreta, David Wong, Ed Zahler, and a semi-anonymous artist named "Dickie." (Dickie was also very helpful in gathering contest entries.) The three submissions that were the most popular with our judges are shown below. After refining them a little, we may end up using all four for various ICPS functions. Thanks and congratulations again to all the contestants, the fruits of your labors were all splendid!

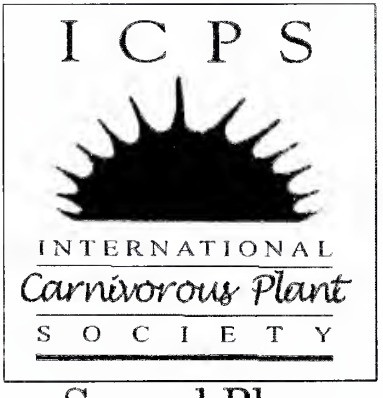
First place: The Venus Flytrap logo by Paul Milauskas was a clear winner with the judges. Since it had its origins in Carnivorous Plant Newsletter's masthead, it provides a sense of continuity to the Society's development. As the first place winner, Paul is also being sent a photograph frame made out of glass. It has a carnivorous plant theme and was hand-made by a Davis, California artisan.

Second place: Rick Meyer's image (again derived from a Venus Flytrap) was popular with many of our judges who saw a clean simplicity in its lines. Comparisons to a rising sun were made.

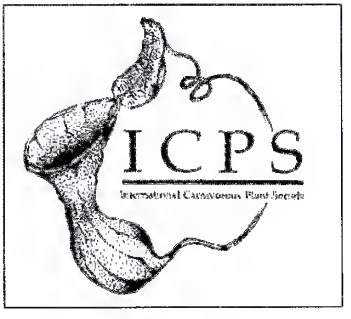
Third place: Vincent UyBarreta's entry is based upon a rendering of *Nepenthes lowii*. This was very popular with our judges who liked its classic feel.

Fourth place (a tie!) : These two logos tired for fourth place. David Wong's was humorously cartoonlike, while Richard Ellis's entry featured a number of species melded together into a strange plant we would love to own!

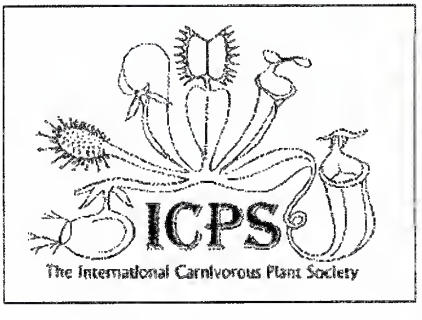
First Place



Second Place



Third Place



Fourth Place

Carnivorous Plants of New South Wales, Australia

Robert Gibson • P.O. Box 1330 • Dubbo • New South Wales 2830 • Australia

Keywords: ecology: *Aldrovanda*, *Drosera*, *Ibicella*, *Utricularia*,
New South Wales (Australia) — observations: *Drosera peltata*

Introduction

The state of New South Wales (hereafter NSW), in eastern Australia (Figure 1A), is home to twenty-one native species of carnivorous plants. These are outlined in the following article. The distribution maps presented are based primarily on the study of specimens at the herbarium of the Royal Botanical Gardens in Sydney. Additionally, *Ibicella lutea* has become established in parts of the state (Auld and Medd, 1987).

NSW can be conveniently divided into five physiographic and botanical regions which are, from east to west: coast, tablelands, western slopes, western plains and far-western plains (Figure 1B). In this article the Australian Capital Territory on the southern tablelands will be treated as part of NSW. This region, 28°—37.5°S and 141°—152.5°E, has an area of just over 800,000km^2.

The native carnivorous plant flora consists of ten species of the Droseraceae

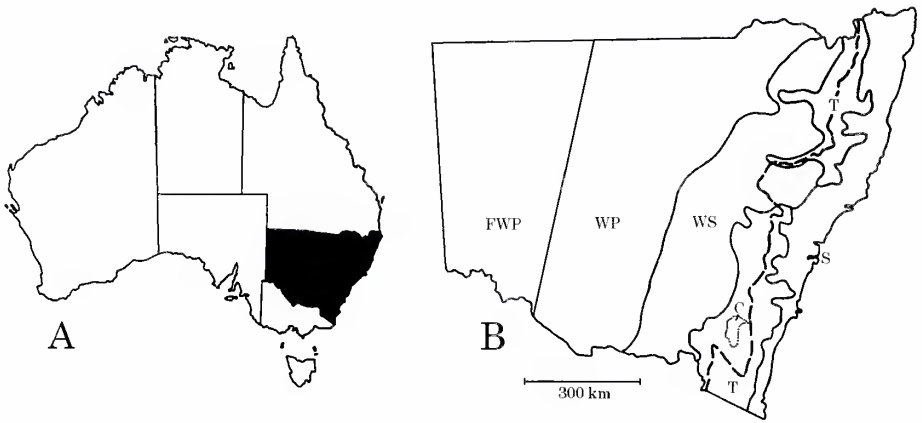


Figure 1: (A) Location map of the state of New South Wales (in black) in eastern Australia. (B) Physiographic and botanic regions of New South Wales: Coast, Tablelands (T), Western Slopes (WS). Western Plains (WP) and Far-Western Plains (FWP). The crest of the Great Dividing Range is indicated by the dashed line. The border of the Australian Capital Territory is dotted in, and the positions of Sydney (S) and Canberra (C) are indicated.

and eleven of the Lentibulariaceae: *Aldrovanda vesiculosa, Drosera arcturi, D. auriculata, D. binata, D. burmannii, D. glanduligera, D. indica, D. peltata, D. pygmaea, D. spatulata, Utricularia australis, U. aurea, U. beaugleholei, U. biloba, U. caerulea, U. dichotoma, U. gibba, U. lateriflora, U. monanthos, U. uliginosa*, and *U. uniflora. Ibicella lutea*, a non-native plant which in the past was considered carnivorous also occurs in NSW. These species will be briefly described below, with accompanying distribution maps (Figure 2).

Family Droseraceae

Aldrovanda vesiculosa has been recorded in one location in NSW (Figure 2C) and is currently considered to be a rare or threatened species. It occurs sporadically along the Queensland, Northern Territory and far northern Western Australian coastal areas of Australia (Erickson, 1968) as well as southeast Asia, from Japan to India, tropical and southern Africa and Europe. It is likely that originally it had a broader distribution within NSW which has been significantly reduced by agriculture and urbanisation.

Drosera arcturi is locally common in swamps and creek banks at or above the tree line, between 1600 and 2100 metres altitude, in the Snowy Mountains around the Mount Kosciusko massif (Figure 2A). It occurs on mountain tops in adjacent Victoria, and in Tasmania and New Zealand from sea-level to alpine elevations (Erickson, 1968). The NSW plants are typical of this summer-growing, winter-deciduous species, and form a loose rosette of three to six erect to semi-erect linear leaves between one and seven cm long. In late spring many plants produce a vertical scape which rises from the base of the third or fourth leaf of the season. The solitary white-petalled flowers are open between mid-December and mid-January. The rosette surmounts a branching, horizontal to inclined shallowly-buried rhizome. To survive the winter, the last two leaves produced in February do not grow to maturity, but form a tight, inverted cone beneath the summer leaves. They recommence growth the following October.

Drosera auriculata is a common and widespread erect tuberous species found throughout the eastern third of the state, from the coast to the western slopes (Figure 2B), and also occurs elsewhere in southeastern Australia and New Zealand (Erickson, 1968). It is an adaptable species, growing from sea-level to 1100 metres in many seasonally to permanently wet environments. Whilst most plants flower between June and November, flowering specimens have been collected throughout the year. This is not surprising since growth may continue as long as the soil remains moist. This is a variable species (Gibson, 1992) which has been considered a subspecies of *D. peltata* (Conn, 1981), however, this appears contrary to classical studies by Vickery (1933), and consistent morphological and ecological differences between both species.

Drosera binata is locally common along the entire coast and adjacent Great Dividing Range (Figure 2A) from sea-level to 1100m and occurs in permanently wet places. This robust and variable species is the largest carnivorous plant in NSW, with lamina often over 30 cm long. Most of the varieties have been informally named by Steve Clemesha (1981). Generally the plants with once-divided leaves occur along the south coast (Clemesha's "T-form"); those with the widest and usually the moderately divided leaves occur around Sydney (*D. binata* var. *dichotoma*); and those with narrow, much-divided leaves occur along the north coast (*D. binata* var. *multifida*). Some populations of the latter have pink-petalled flowers rather than the typical white-petalled flowers. The sweet-scented blooms are produced between October and April, and the plants usually undergo a short period of dormancy from late autumn to early winter. This species also occurs in Victoria, South

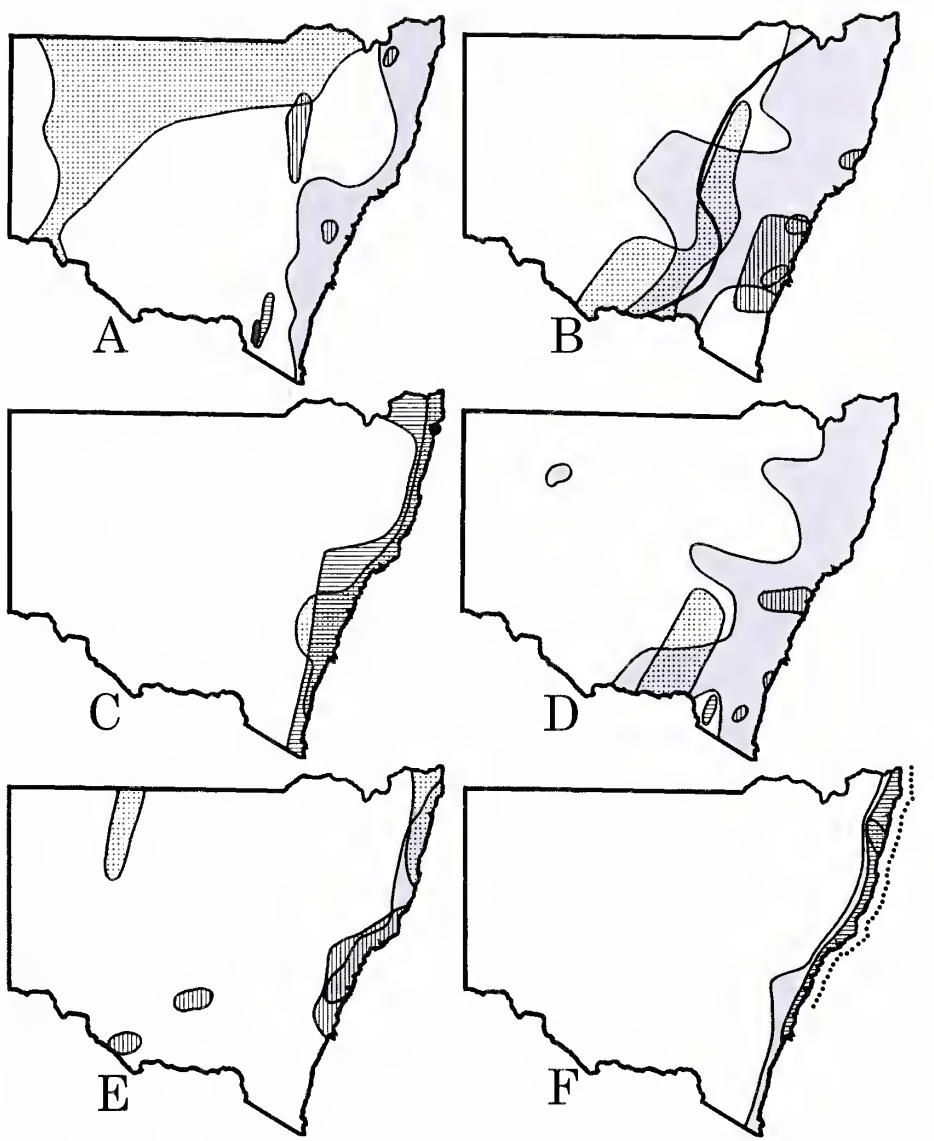


Figure 2: Distribution maps of the native carnivorous plants of New South Wales. (A) Summer-growing *Drosera*: *D. arcturi* (dark grey), *D. binata* (light grey), *D. burmannii* (vertical stripes), *D. indica* (dots), *D. peltata* var. *gracilis* (horizontal stripes). (B) Winter-growing *Drosera*: *D. auriculata* (east of heavy black line), *D. glanduligera* (dots), *D. peltata* variety with green rosettes and pink or white petals (light grey), *D. peltata* variety with red rosettes and white petals (vertical stripes). (C) Generally evergreen Droseraceae: *Aldrovanda vesiculosa* (single black dot), *D. pygmaea* (dots), *D. spatulata* (horizontal stripes). (D) The *Utricularia dichotoma* group: *U. beaugleholei* (dots), *U. dichotoma* (light grey), *U. monanthos* (horizontal lines), *U. uniflora* (vertical stripes). (E) Aquatic *Utricularia*: *U. aurea* (dots), *U. australis* (vertical stripes), *U. gibba* (light grey). (F) Other *Utricularia*: *U. biloba* (coastline range indicated by offshore dots), *U. caerulea* (dots), *U. lateriflora* (light grey), *U. uliginosa* (horizontal stripes).

Figure 3: *Drosera indica*, small plants just developing scapes.

Australia, Tasmania, a small area in southwest Western Australia, and throughout New Zealand (Erickson, 1968).

Drosera burmannii grows in scattered populations in northeastern NSW (Figure 2A), reaching its southern limit in Sydney. It also grows in Queensland and across northern Australia (Erickson, 1968; Marchant & George, 1982; Hart, 1987), and into southeast Asia and western Micronesia (Ziemer, 1987). This summer-growing annual (or short-lived perennial) has red or golden-green rosettes measuring up to 4cm in diameter (see Back Cover). The white or rarely pale pink flowers are produced on one-sided racemes from September to June—it probably flowers year-round in favourable conditions

Drosera glanduligera is a winter-growing annual which produces golden-green rosettes up to 3 cm in diameter. In August to October, multiple short (only 12 cm tall) glandular scapes are produced which bear orange flowers. *D. glanduligera* occurs in the south and central coast (including western Sydney), and across the divide along the length of the western slopes, and in the adjacent south and central western plains, from sea-level to 500 m (Figure 2B). This wide-ranging species grows across subtropical Australia (Marchant & George, 1982).

Drosera indica is an annual, erect species which occurs sporadically in the northwestern and far western plains, primarily along watercourses in the Darling River system, between 100 to 300 metres elevation (Figure 2A). The scrambling plants grow to 25 cm tall with thin, linear leaves as long as 20 cm, and numerous axillary racemes bearing white, or pink flowers (Figure 3). Seeds germinate in summer and plants grow for as long as the soils remain moist; flowers are produced

mainly during May to September. This species has been dispersed down the Darling River system, probably by summer floods—it has been recorded as far south as Euston, Victoria, just upstream of the Darling River's confluence with the Murray River (Erickson, 1968). It is likely the distribution and abundance of this species varies from year to year according to summer rainfall received in the river basin. This species also occurs throughout Queensland and northern Australia, and extends into southeast Asia to Japan and India (Erickson, 1968; Marchant & George, 1982), and also tropical Africa, including Madagascar (Obermeyer, 1970).

Drosera peltata is the most widespread and variable carnivorous plant species in the state (Gibson, 1992) and occurs from the coast to the western plains, up to elevations of 1500 metres. It occurs in all Australian states, New Zealand, and southeast Asia, from Japan to India .(Hooker, 1879; Erickson, 1968; Marchant and George, 1982). At least four distinct variants occur in NSW, each within a well-defined range (Figures 2A, 2B).

1)A *D. peltata* variant with green rosettes and pink (or white) petals occurs in the eastern third of the state, from sea level to 1200 m. (Figure 2B). It is a robust variety with a distinctive golden-green basal rosette (Figure 4) surmounted by one or more green (aging to red) stems which measure up to 50 cm tall. Plants in lower (hotter) or more northerly locations have pink flowers whilst those in cooler environments typically have white flowers. Both forms flower between July and December. It occurs throughout south eastern Australia, including Tasmania, with an isolated population in far northern New Zealand.

2)A *D. peltata* variant with red rosettes and white-petals appears to be endemic to the central eastern part of the state (Figure 2B). It often grows in wetter, sandier substrates than the previously mentioned variant, and has an altitudinal range from sea level to 1100 metres. It produces an attractive red basal rosette and a single olive-green or red erect stem which is up to 30 cm tall. One or more racemes of white flowers are borne from July to December (Figure 5).

3)*D. peltata var. gracilis* occurs only in a very restricted area in the southern tablelands between 800 and 1500 metres (Figure 2A). Found in wet peat soils, it is a slender variety with red rosettes. It grows during the warmer parts of the year, and small white flowers are borne in January and February (McIntyre, 1986).

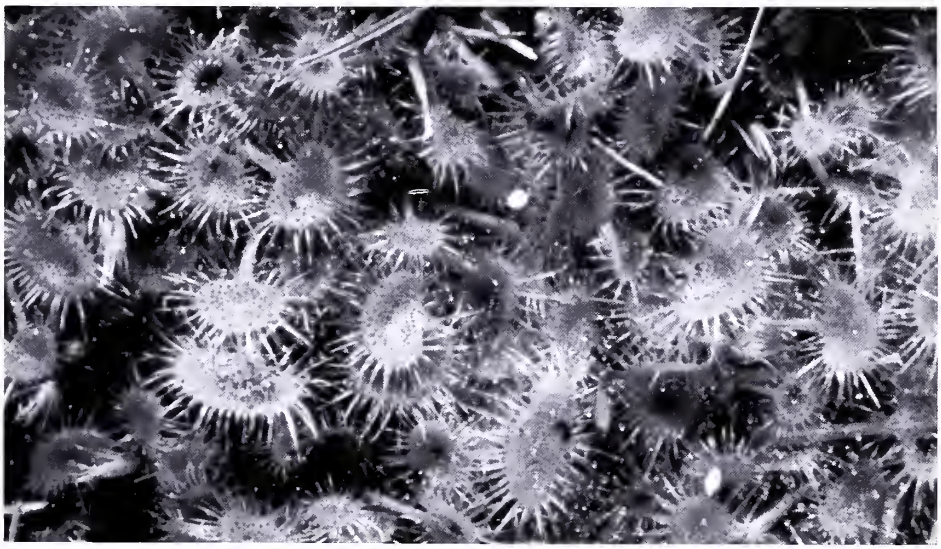


Figure 4: *Drosera peltata* (green-rosette, pink-petal form) growing abundantly in moist clay. The plants are still in the rosette phase.

4)A *D. peltata* variant appears to be restricted to remnant woodland on clay soils in the South Creek basin, 40 kilometres west of Sydney. With short scaped inflorescences, glabrous sepals, and ovoid seeds, up to 0.4mm long, this interesting variant almost appears to be intermediate between *D. peltata* and *D. auriculata*. It was more fully described in Gibson (1993) and is currently under further study.

Some of the *D. peltata* herbarium specimens examined at the Royal Botanic Gardens, Sydney during the preparation of this paper could not be assigned to any of the above variants, and may represent as yet undescribed and new variants. Further studies, including observations of live plants in these areas, are recommended.

Drosera pygmaea is the only pygmy *Drosera* to occur outside of Western Australia. It is recorded from along the coast to the central tablelands, from sea level to 1000 metres (Figure 2C). It occurs throughout southeastern Australia, and in New Zealand (Erickson, 1968). The rosettes grow to 1.8 cm diameter. Each leaf consists of a thin petiole and a round, red lamina measuring up to 2 mm in diameter. In times of drought the leaves die whilst the growing point survives, shielded by the dense, silvery-white cone of stipules. Flowering occurs predominantly from September to June. Gemmae are produced between May and July if the soil is sufficiently moist, and the plant can proliferate rapidly. This diminutive species is easily overlooked, and is probably more widespread than herbarium collections indicate.

Some variation in scape architecture and taxonomic uncertainty exists with this species. Whilst the flowers typically have 4 petals and are solitary, five-petalled flowers are not uncommon, as seen in the photo published in Kondo and Kondo (1983). Rarer still are multi-flowered scapes. Plants with two-flowered scapes have been recorded in southeast Queensland (Stanley and Ross, 1983) and cultivated plants from the New South Wales South Coast may produce scapes with up to five flowers. The taxonomic significance of these variants requires further investigation. In addition, this species has been recorded in two locations in Western Australia (Lowrie, 1989) where the very similar *D. occidentalis* complex occurs. These variants, and the isolated population in southwest Western Australia (Lowrie, 1989) may require further taxonomic investigation.

Drosera spatulata grows along the length of the coast and adjacent tablelands, from sea-level to 1100 metres (Figure 2C). The red rosettes are usually 3-4 cm in diameter, but may reach 8 cm across when they grow under a thin film of water. Pink or white flowers are borne on one-sided racemes from September to July. It is common for the tips of the sepals to spread away from the ripening fruit. Plants in exposed, upland areas undergo a short period of winter dormancy, although they remain evergreen. Some leaf shape variation occurs—the leaves may be narrowly wedge-shaped, or have a slightly flaring petiole with a rounded lamina—but in all cases the stalked retentive glands occur over the length of the leaf. Some forms have unusually large flowers. A complete study of this common and widespread species would probably yield some surprising information. This species is found throughout southeastern and eastern Australia, New Zealand, southeast Asia from Indonesia to Japan (Erickson, 1968), and western Micronesia (Ziemer, 1987).

Family Lentibulariaceae

Utricularia aurea is a robust, evergreen, perennial aquatic species found primarily on the north coast, with infrequent records in the intermittent Paroo River in the far western plains (Cunningham *et al.*, 1992), always north of 31°S and from sea level to 200 metres elevation (Figure 2E). It commonly grows in farm dams. The leaves, which are produced all year, have three primary segments which are further

Figure 5: *D. peltata* (red-rosette, white-petal form) growing with *Drosera spatulata* on the south coast.

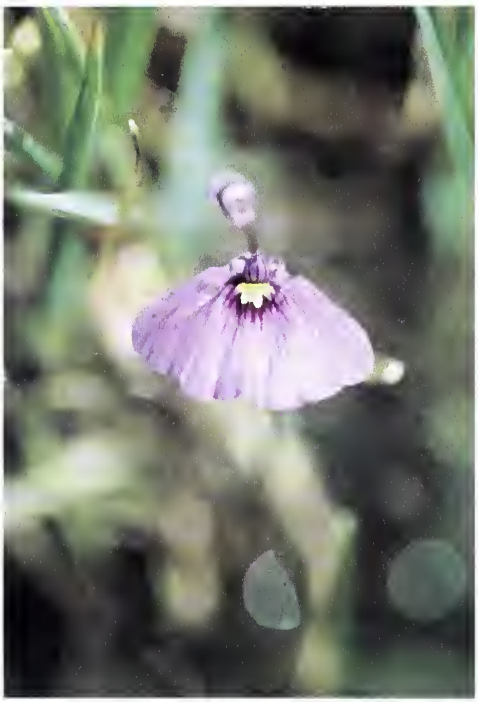


Figure 6: *Utricularia beaugleholei* in flower. Note the whorled arrangement of the flowers, the prominent yellow-striped palate and the reflexed margins of the upper lip. Photo by Sean Spence.

Figure 7: *Utricularia biloba* flowering in cultivation.

finely divided (Taylor, 1989). Yellow flowers are produced from December to May. This species also occurs in northern Australia, and southeast Asia, to Pakistan and Japan (Taylor, 1989).

Utricularia australis is a robust aquatic species which is similar to *U. aurea* (Taylor, 1989) but it may be identified by its leaves having only having two primary segments. Yellow flowers occur infrequently from January to July. This species stops growing in autumn and produces turions: compact, dormant, hairy growing points which recommence growth in mid-spring. It is found along the coast south of 31.5°S, the adjacent southern tablelands, and sporadically in the southwest slopes and western plains, from sea-level to 600 metres (Figure 2E). This adaptable species may occur in irrigated rice fields and also amongst waterlilies on sale at Sydney nurseries. It occurs in every Australian state (except Queensland), in New Zealand, tropical and temperate Asia, tropical and South Africa and most of Europe (Taylor, 1989).

Utricularia beaugleholei is a terrestrial species closely related to *U. dichotoma*. It is known only from five collections in NSW, from the southern tablelands and southwest slopes, at elevations between 100 and 500 metres (Figure 2D). The purple flowers are borne in multiple whorls of three between September and March. The strongly reflexed upper petal and radially arranged, 4-11 narrow yellow ridges at the base of the large, semi-circular lower petal are distinctive (Figure 6). This species also grows in central and western Victoria, and far-southeast South Australia (Gassin, 1993).

Utricularia biloba is a distinctive species known from only a few locations on the north and central coast, extending just south of Sydney (Figure 2F). It typically grows as an affixed aquatic in water up to 80 cm deep, and bears leaves up to 10 cm long which are divided into many filiform segments. In shallower water or exposed wet sand, the leaves are shorter and less divided. Traps are usually only produced underground. In February to June the substantial (up to 50 cm tall), often branching scapes are produced which carry up to 30 attractive dark purple flowers. The bilobed lower petal bears two white and yellow stripes on its bulbous palate (Figure 7). The broken range of this species may be a product of the last sea level rise 18000 to 6000 years ago, which flooded and fragmented a once extensive barrier beach system with interdune lakes and swamps (Roy, 1984). More recently, urban sprawl and agriculture have ruined many other locations. This species is endemic to the east coast and extends into southeastern Queensland (Hart, 1987; Taylor, 1989).

Utricularia caerulea is found only on the north coast, north of 30°S, at altitudes of 0—200 metres (Figure 2F). There is an informal record of it occurring as far south as Sydney (Erickson, 1968, page 73). This variable terrestrial species flowers from August to April and has purple or white flowers clustered at the top of 30 cm tall scapes. The horizontal nectary spur projects beyond the apex of the lower petal, which has four parallel yellow stripes at its base. This wide ranging species also occurs in Queensland and northern Australia, southeast Asia, from India to Japan, and Madagascar (Taylor, 1989).

Utricularia dichotoma, an attractive and variable species, is the most widespread bladderwort in the state and occurs from the coast to western slopes, and less commonly in the southwest and far-western plains (Figure 2D). It grows from sea level to 1500 metres altitude. It flowers year-round, though most commonly in the warmer months, bearing dichotomously-arranged or singularly-held purple (rarely white) flowers on a scape 10—50 cm tall. The flowers have a flat upper petal and a semicircular to tear-drop shaped lower petal. The palate has two or three prominent yellow ridges with smaller, peripheral ridges. The western-most occur-

rence of this species in NSW is an interesting one in a number of moundsprings. It occurs in all states except the Northern Territory (Taylor, 1989).

Utricularia gibba is the smallest aquatic bladderwort in the state and occurs in the north and central coasts, from sea level to 300 metres altitude (Figure 2E). It is a perennial species with a conspicuously coiled growing tip and sparsely divided, filiform leaves up to 2 cm long which bear 1-4 traps. It flowers from September to June and is particularly floriferous when in drying pools and on mud banks. Whilst commonly found in most rivers and lakes, this species is equally at home in farm dams and amongst waterlilies on sale in nurseries. It is one of the most widespread of all carnivorous plants and occurs in Queensland, the Northern Territory, Western Australia, New Zealand, New Caledonia, southeast Asia, southern Europe, and throughout Africa and the Americas (Taylor, 1989).

Utricularia lateriflora grows along the coast and adjacent tablelands, from sea level to 1000 metres altitude (Figure 2F). This small terrestrial species produces remarkably tough scapes which stand up to 10 cm tall and bear 1-8 purple (rarely white) flowers. This deep-rooted, drought-tolerant species probably occurs elsewhere in the state. Its total range is from southeast Queensland to southeast South Australia, including Tasmania (Taylor, 1989).

Utricularia monanthos is an attractive but small terrestrial species restricted to the southern tablelands between 1150 and 1650 metres altitude (Figure 2D). One or two dark-purple flowers are produced on short scapes from December to March. The lower petal is tear-drop shaped, with two or three yellow ridges at its base. The leaves are up to 5 cm long, and its 3 mm × 2 mm traps may be studied easily with the naked eye. In NSW it grows separate from all other bladderworts but it may be accompanied by *D. arcturi*. This species also occurs in mountain districts in Victoria, Tasmania and New Zealand (Taylor, 1989). From my studies I am not convinced of the recent union of this species with *U. novae-zelandiae*.

Utricularia uliginosa is a small but distinctive species found along the coast north of 35.5°S, from sea level to 200 metres altitude (Figure 2F). It grows either as a terrestrial species or as an affixed aquatic; in the latter case it can produce remarkably large leaves up to 18 cm long. The erect scapes bear one to five purple flowers. The upper petal scarcely projects beyond the calyx. The horizontal, narrowly wedge-shaped lower petal is dominated by an axial dome. This widespread species also occurs in Queensland and across Northern Australia, in New Caledonia, and in southeast Asia to Japan and India (Taylor, 1989).

Utricularia uniflora is a widespread, locally common species recorded from the central coast and central and southern tablelands, from sea level to 1100 metres elevation (Figure 2D). Although similar to *U. dichotoma*, it is a distinctive species. The purple flowers are produced singularly (rarely in pairs) mainly from November to June. They have a distinctive semi-circular lower petal, paler in the center than the margins, with radially arranged, yellow, white and purple palate ridges of differing lengths. This species occurs from south eastern Queensland to Victoria and western Tasmania (Taylor, 1989).

Family Martyniaceae

Ibicella lutea is a widely established weed from South America which may be carnivorous (Juniper *et al.*, 1989). This summer-growing annual is found from the coast to the western slopes and its tough, hooked fruit cause financial losses in the wool industry (Auld and Medd, 1987). The majority of the plant is covered with short-stalked retentive glands which efficiently trap small flying insects. The related *Martynia annua, Proboscidea louisianica* and *P. fragrans* (from the Americas) are

also established in eastern Australia, including NSW, and are similarly covered in stalked retentive glands (Auld and Medd, 1987). They have been proven to be only sub-carnivorous (at most). Perhaps they depend on bugs for the digestion of their prey, comparable to other sub-carnivorous plants like *Byblis* or *Roridula*.

Conclusion

From the distribution maps it is evident that the native carnivorous species grow in five physiographic regions, in a range of intermittently to permanently wet habitats. Most are found along the coast and adjacent tablelands, with a concentration of fifteen species on the central coast around Sydney. Only seven species extend west of the Great Dividing Range. The majority of species are widespread and common and extend to other parts of eastern Australia, and often overseas. Only *Aldrovanda vesiculosa* is classed as rare or endangered within the state. The two endemic *Drosera peltata* variants are currently undergoing further study.

Acknowledgements

I wish to thank the helpful staff at the Royal Botanic Gardens herbarium in Sydney for granting me study access to the collection. I also wish to thank Robert Gassin for thought-provoking correspondence and for the exchange of data.

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Erratum

In issue 28:1, page 26, the Editor's comment was accidentally truncated. The last line should have read, "These latter have previously been attributed to *N. veitchii* or a hybrid involving this species."

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D. californica—Josephine Co., Oregon
D. californica—Nevada Co., California
Darlingtonia 'Othello'
Nepenthes ventricosa
N. ventricosa × *alata*
N. ventricosa × ?
P. vulgaris
Sarracenia flava
S. flava—Ben Hill Co., Georgia
S. flava—New Bern, Craven Co., North Carolina
S. flava—Fitzgerald, Ben Hill Co., Georgia
S. flava—Hampstead, North Carolina
S. leucophylla
S. minor—Fitzgerald, Ben Hill Co., Georgia
S. purpurea subsp. *purpurea*
S. purpurea subsp. *purpurea*—north Ohio plains
S. purpurea subsp. *venosa*—Hampstead, North Carolina
S. purpurea subsp. *purpurea*—Manchester, NJ × *S. purpurea* subsp. *venosa*—Hampstead, North Carolina
S. minor & *psittacina*—Fitzgerald, Ben Hill Co., Georgia, seeds mixed
S. alata × *leucophylla*
S. leucophylla × *oreophila* selfing
S. oreophila × *purpurea* subsp. *purpurea* selfing
Drosera aliciae—short leafed form
D. anglica—Switzerland
D. anglica—(California × Hawaii clones)
D. binata—Coromandel, NZ
D. burmannii—Beerwah, Queensland
D. burmannii—giant form, Mann River
D. capensis—green
D. capensis—narrow leaf
D. capensis—purple flower
D. capensis—white flower
D. capillaris
D. capillaris—long leaf
D. collinsiae
D. filiformis var. *filiformis*
D. filiformis var. *filiformis*—North Carolina
D. filiformis var. *filiformis*—St. Helena, North Carolina
D. filiformis var. *filiformis*—New Jersey
D. filiformis var. *filiformis*—Manchester, New Jersey
D. intermedia—Carolina giant form
D. lowriei—small red form
D. macrantha subsp. *macrantha*—pink
D. rotundifolia—Czech Republic
D. rotundifolia—Mendocino Co., California
D. rotundifolia—Nevada Co., California
D. rotundifolia—Manchester, New Jersey
D. spatulata
D. spatulata—Hong Kong
D. spatulata—Japan
D. spatulata—Kanto
D. —sp. 2, Cuba
D. stolonifera subsp. *stolonifera*

Miscellaneous:
Ibicella lutea—5 seeds per packet
Mimosa pudica—sensitive plant

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Tissue Culture Laboratory

Your source for Nepenthes, Heliamphora and Cephalotus
All plants are larger than 2 inches in diameter unless noted.

Species	Price	Origin
C. follicularis (2 plants, 1-2" each)	$15	Australia
H. heterodoxa (divisions, 4" tall)	$80	Venezuela
H. ionasi	$80	Ilu Tepui, Venezuela
H. minor (divisions, 4" tall)	$80	Auyan-Tepui, Venezuela
H. nutans (divisions, 4", tall)	$80	Cerro Kukenan, Venezuela
H. nutans	$38	Cerro Kukenan, Venezuela
N. alata	$20	Philippines
N. alata, red trap(rooted cutting, 4-6" diam)	$40	Philippines
N. albo-marginata (spotted)	$40	Malaysia
N. albo-marginata-red	$35	Malaysia
N. ampullaria	$35	Borneo
N. ampullaria	$35	Sipitang, Borneo
N. bicalcarata (>3" diameter)	$65	Borneo
N. bongso (talangensis)	$50	G. Talang, Indonesia
N. burbidgeae	$125	Kinabalu
N. burkei	$35	Philippines
N. caranculata	$48	G. Sago, Sumatra,Indonesia
N. clipeata	$99	Malaysia
N. edwardsiana (1.5")	$125	Trus Madi, Sabah, Malaysia
N. deaniana	$65	Palawan
N. ephippiata	$77	G. Rajah, Kalimantan
N. eustachya	$77	
N. eymai (N. infundibuliformis)	$55	G. Lumut, Sulawesi, Indonesia
N. fusca	$40	
N. fusca Madi	$40	Tambunon Road near Trus
N. gracilis	$10	Talangka Rajah, Borneo
N. gracilis (12" vine)	$34	
N. gracillima	$44	Genting Highlands, Malaysia
N. gymnamphora	$47	G. Singalang, Sumatra
N. hirsuta (rooted cutting, 4-6" diam)	$35	Malaysia
N. insignis	$59	E. Biak, Indonesia
N. khasiana	$15	Assam, India
N. lowii	$60	Brunei
N. lowii	$60	G. Mulu, Sarawak, Malaysia
N. lowii	$60	Trus Madi, Sabah, Malaysia
N. lowii	$75	G. Murud, 2060 meters
N. lowii	$75	M. Kinabalu
N. macfarlanei	$40	Genting Highlands, Malaysia
N. madagascariensis	$15	Madagascar
N. maesolensis	$55	Madagascar
N. maxima	$30	Rantepao, S. Sulawesi,Indonesia
N. maxima	$47	Anggi Lakes
N. maxima (>6" rooted cutting, produces numerous 6" speckled traps)	$55	Indonesia
N. merrilliana	$70	Nunok Island
N. mirabilis	$12	Kelam, Borneo
N. mirabilis	$12	Cape York, Australia
N. mirabilis (Echinostoma)	$55	
N. muluensis	$85	G. Mulu
N. murudiensis	$77	G. Murud
N. neoguniensis	$82	Irian Jaya
N. northiana	$82	Near School, Bau, Sarawak
N. pectinata	$75	G. Singalang, Sumatra
N. pervillei	$35	Seychelles
N. rafflesiana	$37	Malaysia
N. rajah	$40	Mt. Kinabalu, Sabah, Malaysia
N. reinwardtiana	$40	G. Silam
N. sanguinea (>4" diam)	$35	Genting Highlands, Malaysia

Species	Price	Origin
N. sp.	$45	Legaspi, Phillipines
N. spectabilis (rooted cutting)	$65	Malaysia
N. spathulata	$85	Greenhouse
N. stenophylla	$55	Bario, Sarawak, Malaysia
N. tentaculata	$45	Mt. Kinabalu, Sabah, Malaysia
N. tentaculata	$45	G. Murud
N. thorelii	$45	Phuk Radung, E. Thailand
N. tobaica	$45	
N. tomoriana	$50	Lampia, Gulf of Tomori, Sulawesi
N. treubiana (N. sumatrana)	$80	Sumatra
N. treubiana(N. sumatrana) (6" diam)	$136	Sumatra
N. truncata	$50	Philippines
N. truncata (>5" diam)	$85	Philippines
N. truncata (>14" diam)	$195	Philippines
N. veitchii (highland)	$60	Batu Lawi, Sarawak, Malaysia
N. veitchii (lowland)	$60	Sungai Samba, Borneo
N. ventricosa (>4" diam)	$9	Philippines
N. ventricosa >6" diam, rooted cutting, develops large (8") green traps with dark red peristome, very unusual!)	$35	Philippines
N. vieillardii (>4" diam)	$40	New Caledonia
N. villosa (1.5" diam)	$100	Mt. Kinabalu, Sabah, Malaysia

Selected hybrids

N. x (bicalcarata x ampullaria)	$35	Sipitang, Sabah, Borneo
N. x (bongso x maxima)	$55	
N. x (fusca x burbidgeae)	$50	
N. x hookeriana	$45	Natural hybrid between N. rafflesiana and N. ampullaria
N. x (khasiana x truncata)	$30	
N. x (mirabilis x khasiana)	$30	
N. x (singalana x truncata)	$30	
N. x (spathulata x veitchii)	$50	
N. x (thorelii x veitchii)	$37	
N. x (truncata x maxima)	$50	
N. x (truncata x ventricosa)	$45	
N. x (veitchii x lowii)	$55	
N. x (ventricosa x inermis)	$35	

Victorian Hybrids

Unique and Spectacular Traps

N. x chelsonii (>6" rooted cutting)	$30	London, Late 1800's
N. x coccinea (>6" rooted cutting)	$30	London, Late 1800's
N. x dormanniana (>6" root. cutting)	$30	London, Late 1800's
N. x dyeriana (>6" rooted cutting)	$65	London, Late 1800's
N. x edinensis (>6" rooted cutting)	$25	London, Late 1800's
N. x mixta (>6" rooted cutting)	$55	London, Late 1800's
N. x wrigleyana (>6" rooted cutting)	$35	London, Late 1800's

Books

Nepenthes of Mt. Kinabalu Original Edition	$75	Price includes shipping/handling
Nepenthes of Borneo C. Clarke	$65	Price includes shipping/handling

Ordering Instructions: SEND NO MONEY NOW!
Send orders to: John de Kanel, P.O. Box 61227, King of Prussia, PA, 19406 [de_kanel@email.msn.com; (610) 539-9351]
We will bill you when plants are ready for shipment. Please give your phone number, mailing address and E-mail address (if available) when ordering. All plants are artificially propagated by rooting cuttings or by tissue culture, and are hardened off in the greenhouse for at least 2 months before sale. Plants are guaranteed for 30 days. Plants will not be shipped between November 15 and March 15! Shipping costs: within U.S (~$10), outside U.S. (Air mail: ~$25, CITES: $17, Phytosanitary Certificate: $23. Prices are subject to change without notice. Orders over $2000 or 35 plants of a species receive a 40% discount.